Ulnar Lengthening/Reconstruction of Interosseous Membrane in Treatment of Osteochondroma

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Abstract

Background We aim to measure the quality of life and clinical and functional outcomes of a patient who had undergone ligament reconstruction of the forearm interosseous membrane, using brachioradialis tendon more ulna distraction osteogenesis in treatment with multiple cartilaginous exostosis.

Case Description We present a 11-year-old boy with congenital deformity in his right, dominant forearm,Type IIb by Masada classification. Distraction of the ulna, resection of exostosis, and reconstruction of the distal part of the interosseous membrane was performed. One year later, the patient experienced good evaluation. Wrist flexion was 70 degrees, extension was 60 degrees, radial deviation was 20 degrees, and ulnar deviation was 30 degrees. Forearm pronation was 60 degrees and supination was 90 degrees. Elbow flexion was 120 degrees, extension was −5 degrees, and digit motion was full. DASH score of 5, VAS of 0, and grip strength of 92% compared to the unaffected side were obtained. Forearm radiographic aspects showed healing of the distraction, articular congruency, the distal radioulnar joint (DRUJ), and radiocapitellum joint. The distraction distance was 28 mm, the distraction period was 67 days, the consolidation period was 96 days, and the period of fixator treatment was 92 days. The distraction speed was 0.5 mm/day. Good stability and joint congruency of the DRUJ and elbow were obtained. Good radiographic, clinical, and functional results were obtained improving the life quality of that patient.

Literature Review The treatment of forearm deformities is difficult and complicated. There is no consensus to the overall management. As there is still a lack of long-term results, the indications for surgery, various surgical options, and the timing of the intervention have been a matter of controversy in the literature. Would DRUJ be stable when ulnar lengthening is combined with excision of exostosis? Is it possible to reduce the radial head with this technique?

Keywords
- multiple osteochondromas
- forearm deformity
- relative ulnar shortening
- wrist deformity
- interosseous membrane reconstruction

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Clinical Relevance We would like to suggest an interosseous membrane (distal oblique band) reconstruction to improve this treatment. We believe this suggestion could maintain DRUJ and elbow more stable and functional. We agree that the best time to perform the corrections is early and gradually. We prefer to correct the ulna, radius, DRUJ and elbow in many steps than in only one procedure.

Multiple cartilaginous exostoses (MCE) is a disorder of endochondral bone growth with autosomal-dominant inheritance that is characterized by the development of several abnormal cartilage-covered bone prominences,[1] and often indicates severe deformity of forearm bones indicating loss of forearm rotation, wrist, and elbow malfunction and sometimes pain in juvenile.

In the present case, we performed ulnar lengthening by callotasis associated with resection of exostosis and stabilization the distal radioulnar joint (DRUJ) with distal interosseous membrane reconstruction using brachioradialis (BR) tendon.

Case Report

An 11-year-old boy visited our institute with congenital deformity in his right, dominant forearm. Wrist flexion was limited to 40 degrees of extension, 50 degrees of flexion, 10 degrees of radial deviation, and 20 degrees of ulnar deviation. Forearm pronation was limited to 10 degrees and supination to 20 degrees. Elbow flexion was 90 degrees, and extension was 0 degrees. Radiograph indicated the shortening of the ulna with dislocated radial head with the epiphyseal exostosis (►**Fig. 1**). The Disabilities of the Arm, Shoulder and Hand (DASH) score of 42 and visual analog scale (VAS) of 5 were noted. Grip strength was 65% for the unaffected side.

Before he underwent surgery, forearm radiographs and three-dimensional-computed tomography reconstructed images were used to formulate the structured plan.[2] Fluoroscopy was used to mark the osteotomy level, and pin insertion areas in the ulna and the monolateral external fixator (Orthofix, Lewisville, TX) was placed into the proximal to the distal ulna. Different angles of pin placement allowed correction of the rotational and angular deformity of the ulna (►**Fig. 2**). After the ulna was lengthened to levelized the

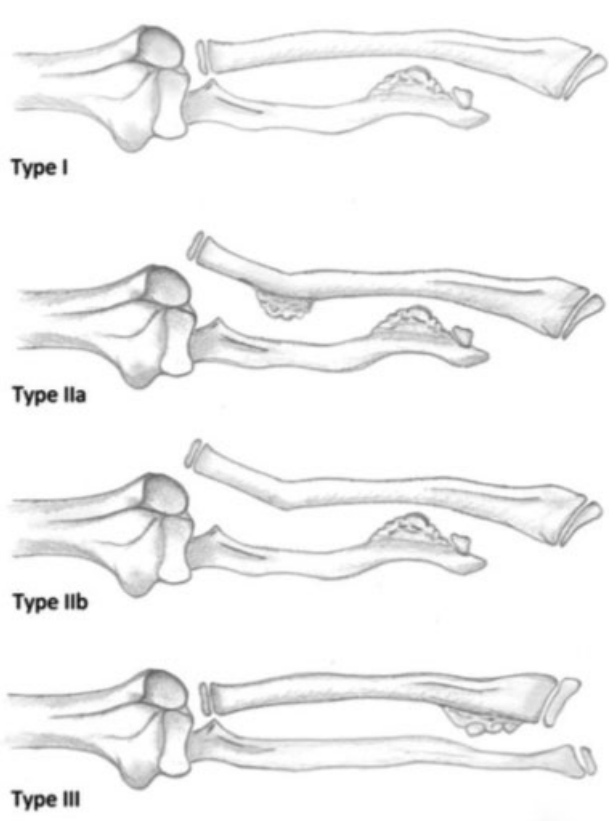

Fig. 1 Schematic drawing of the Masada classification for forearm deformity in patients with multiple osteochondromas.

Fig. 2 Forearm radiograph aspect: Preoperative.

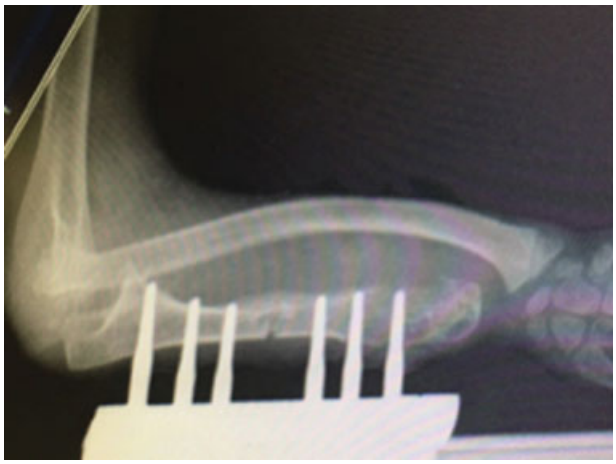

Fig. 3 Forearm radiographic aspect: Monolateral lengthening fixator was mounted onto ulna.

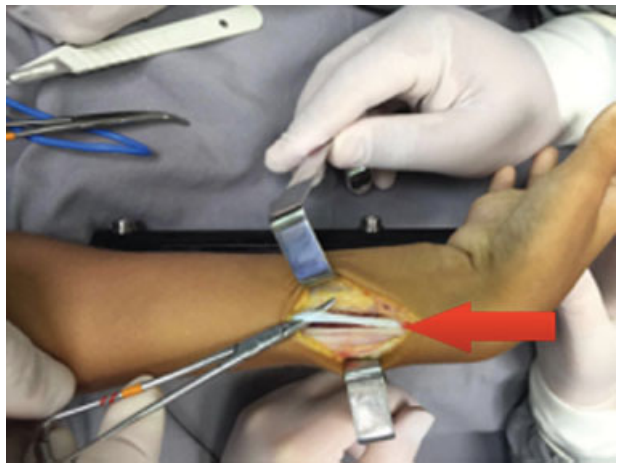

Fig. 4 Intraoperative aspect showed the brachioradialis tendon graft dissected.

ulnar variance (2 months), resecting the exostosis and reconstruction of the distal oblique band of the interosseous membrane were performed. The BR muscle tendon was harvested and elevated from its insertion at the radial styloid to the proximal myotendineous transition (►**Fig. 3**). The FiberLoop (Arthrex Inc., Naples, FL) was applied on the proximal end of the BR tendon. The oblique tunnel of the radius at the insertion of the BR to the distal one-fifth of the ulna was made using a drill under fluoroscopic control and extended to the distal ulna. The tendon passed through the radial, then the ulnar tunnel with the guide wire. Fixation of the graft with two specific Bio-Tenodesis screws (Arthrex Inc.) was performed in each tunnel with a certain tension to stabilize the DRUJ (►**Fig. 4**). The forearm was fixed in the neutral position with a transverse Kirschner-wire on the radius and ulna for 6 weeks (►**Fig. 5**).

After adequate lengthening of the ulnar with satisfactory bone formation was achieved, the external fixator was removed (►**Fig. 6**). The distraction distance of 28 mm, the distraction period of 67 days, the consolidation period of 92 days, and the period of lengthening of 116 days were noted. The distraction speed was 0.5 mm/day (►**Fig. 7**).

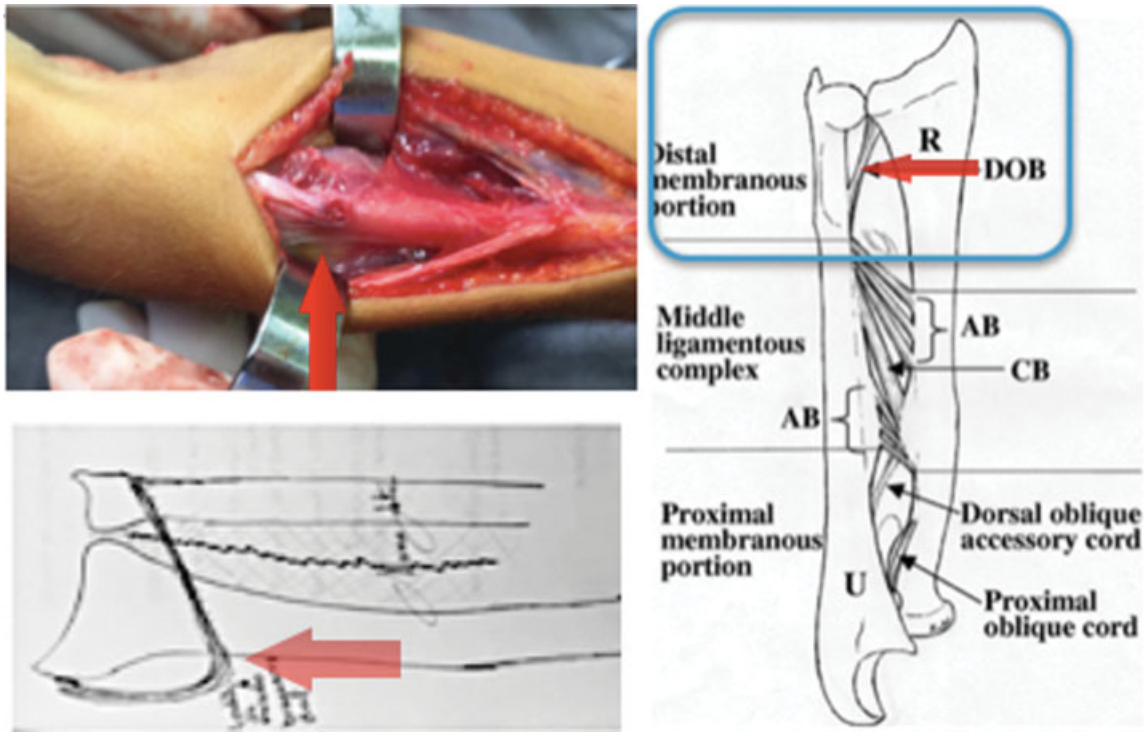

Fig. 5 Schematic drawing and intraoperative aspect: Pass brachioradialis tendon graft into radius/ulna tunnels to substitute the distal oblique band by an interosseous membrane.

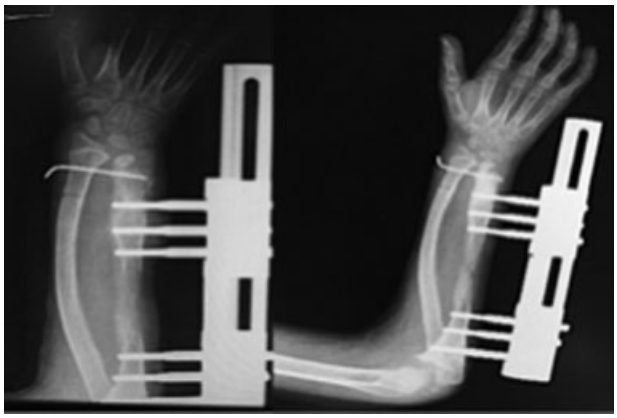

Fig. 6 Forearm radiographic aspect: Postoperative showed external fixator in ulna, radial head reduction, distal radioulnar joint congruency, and callus in maturation.

After 1 year of the surgery, the boy obtained good wrist, forearm, and elbow range of motion, 70 degrees flexion, 60 degrees extension, 20 degrees radial deviation, 30 degrees ulnar deviation, 60 degrees pronation, 90 degrees supination, 120 degrees elbow flexion, and −5 degrees elbow extension (►**Fig. 8**). The motion of the digits was normal. DASH score of 5, VAS of 0, and grip strength of 92% compared to the unaffected side were obtained. Radiographs indicated lengthening of the ulna with good congruency on the DRUJ and radiocapitellar joint with good radiographic parameters (►**Fig. 9**), (►**Table 1**).

Discussion

MCE is a disorder of endochondral bone growth with an autosomal-dominant inheritance that is characterized by the development of several abnormal cartilage-covered bone prominences. These primarily benign osteochondromas are predominantly located in the metaphyseal regions of long bones,[1] thus often indicates deformity in the long bone in juvenile.

The different deformities of the forearm are classified according to the Masada deformity scale.[3] Forearm rotation is most severely impaired in type I, whereas elbow motion is normal. Type II shows restriction of both elbow movement and forearm rotation. Radial deviation of the wrist is severely restricted in both subtypes. Type III retains most forearm and elbow movement, but an ulnar deviation of the wrist is limited and often painful.

The treatment of forearm deformities is difficult and complicated. The indications, surgical options and the timing of surgery can vary. Simple resection of exostosis preventing further deformity progression with lengthening of the ulna using external fixator often combined with simultaneous radial correction procedures.[2,4]

In the present case, we performed ulnar lengthening by callotasis associated with resection of exostosis and stabilization the DRUJ with distal interosseous membrane reconstruction[5] using the BR tendon passing through the distal end of the radius to the distal one-fifth of the ulna. Successful clinical results were obtained without any complications in this case. However, longer follow-up is needed because of the patient's age.

Fig. 7 Forearm radiographic aspect: Postoperative showed callus healing and good relationship between the forearm bones and elbow distal radioulnar joint.

Fig. 8 Clinical aspects: 1 year postoperatively.

Fig. 9 Radiograph forearm aspect: Preoperative and postoperative.

Table 1 Comparative index forearm radiographic (anteroposterior view)

Index	Preoperative	Postoperative	Standard
CS (%)	40	50	50
UV (mm)	9.3	0	15
RAA (degrees)	20.1	24.5	15–30
RB (mm)	10.11	12.5	12

Abbreviations: CS, carpal slip; RAA, radial articular angle; RB, radial bowing; UV, ulnar variation.

Note

The research presented here was approved by and was in accordance with the ethical standards of the Faculdade de Medicina do ABC Ethics Committee on human experimentation by no. 1750176. An informed consent document was provided to the patient, who read and signed it according to his will.

Funding

None.

Conflict of Interest

None.

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